

# *Modern Concepts of Cardiovascular Disease*

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## PERICARDIAL PARACENTESIS

While aspiration of the pericardial sac has been an accepted technique for the diagnosis and treatment of pericardial effusion for many years, most physicians continue to regard this procedure with concern and hesitation. Opinion is often divided concerning the feasibility of paracentesis in the absence of tamponade, the indications for the procedure, the proper site for puncture, the dangers inherent in the maneuver, and the experience and training required of the operator. We have reviewed the subject of pericardial aspiration and attempted to answer some of these problems by asking the opinions of leading cardiologists and surgeons in this country\*.

Needle puncture of the pericardium has been performed since 1819 when Romero trephined the sternum to aspirate an effusion. Shortly thereafter, Jowett and Schuh used trocars without surgical incision. In 1870, Dieulafoy first described one of the current techniques of needle aspiration with puncture in the fourth and fifth left interspaces beyond the cardiac border. Subsequently, Baizeau, Delorme, and Mignon recommended the left parasternal line in the fifth and sixth interspaces. Rotch utilized the fifth right intercostal space close to the sternum. In 1899, Jaboulay, following an earlier suggestion of Larrey, approached the pericardium through the left costoxiphoid angle. Curschmann tapped the pericardial sac through the posterior chest wall in the seventh and eighth interspaces along the scapular line. This approach was particularly recommended for children by Sutton, who felt that fluid accumulated more readily in the posterior pouch because of fixation of the heart anteriorly by the great vessels.

The divergent opinions commonly expressed regarding the best approach for aspiration and the dangers of the method have discouraged many from attempting a pericardial tap. Although temerity should not be encouraged, delay may hinder accurate diagnosis and seriously threaten the lives of those with tamponade. The opinions of the twenty-one authorities answering our questionnaire should help to formulate a method for this indispensable procedure.

The approach preferred for pericardial paracentesis was listed from the inquiry as follows:

ROUTE	CHOICE	
	1st	2nd
Apical	9	7
Subxiphoid	8	5
4th Interspace		
Parasternally		
Right	2	3
Left	2	1
Posterior Thoracic (Scapular)	0	2

Nine favored an apical route in the fifth or fourth left interspace just within the outer border of cardiac dulness; eight chose the subcostal route either through the left costoxiphoid notch or below the ensiform cartilage; four recommended the fourth interspace near the sternum, two favoring the right and two the left of this landmark. One of these, a surgeon, strongly advocated surgical incision to the left of the sternum and aspiration under direct visualization.

If the first site elected could not be used or resulted in an unsuccessful tap, seven of those who initially chose the subxiphoid route recommended the apical approach as an alternative. Five of the group selected the subxiphoid route for a second attempt.

These results clearly indicate a general preference for either the anterior apical or subxiphoid approach for pericardial paracentesis. While the apical method is usually preferred in our clinic, it is often difficult to choose between the two routes. In general, we tap at the outer border of cardiac dulness unless left pulmonary or pleural disease is present, the chest wall is unusually obese in this area, or in the case of women, the breast cannot be easily retracted. Under these circumstances the subxiphoid route is chosen.

### *Technique for Apical Approach*

The patient is supported in a sitting position in bed and the left border of cardiac dulness and left diaphragm are outlined by percussion. Fluoroscopy may be necessary to check these landmarks. The fifth interspace is identified. The skin of this area is prepared widely with an antiseptic solution. Towels are draped about the field. The skin, subcutaneous tissue, and pleura are infiltrated freely with 2% procaine. A short-beveled #18 needle, attached to a five or ten cc. syringe for ease of manipulation, is inserted in the fifth left interspace in line with the outer border of dulness but beyond the apical impulse if this can be identified. The needle is directed posteriorly and medially toward the spine, while suction is maintained with the plunger. The depth of penetration will vary, but usually does not exceed 7 to 8 cms. If a grating sensation is felt or motion synchronous with the heart beat imparted to the needle, it should be withdrawn slightly. If fluid is not obtained in 2 or 3 advances of the needle, the attempt should be abandoned to avoid trauma. When fluid is obtained, it is generally safer to connect the needle to a larger syringe by means of a soft rubber tube and a three-way stopcock in order to complete the aspiration without further movement of the needle.

### *Technique for Subxiphoid Approach*

The patient is placed in a reclining position with pillows under the back to cause the xiphoid process to protrude anteriorly. The area about the xiphoid is prepared with the usual aseptic technique and anesthetized by the infiltration of 2% procaine solution. A lumbar puncture needle without stylet (17 or 18 gauge and 8 to 10 cms. in length) is inserted just be-

low and close to the xiphoid process in the midline. The tip of the needle is directed upward and kept in contact with the posterior side of the xiphoid and the sternum. As the needle is slowly and carefully inserted, the adapter end of the needle is pressed down against the skin of the abdomen. In this way the needle is inserted along the posterior surface of the sternum until it enters the pericardial cavity. In children under 5 years of age, the tip of the needle must penetrate to a depth of about 5 cm. in order to reach the pericardial sac. The depth will vary somewhat in adults depending upon body build and the position of the diaphragm but averages 6 to 7 cms. If fluid is not readily obtained the procedure may be varied by directing the bevel of the needle 45° posteriorly and pointing it toward the left shoulder.

There are two indications for pericardial aspiration. The first is for the treatment of cardiac tamponade with classical clinical signs of engorged veins in the neck, distant heart sounds, and low systolic blood pressure with paradoxical pulse. Absence of cardiac pulsations as seen by fluoroscopy helps to establish the diagnosis, especially in the presence of clear lung fields. Angiocardiography is particularly valuable when the diagnosis is difficult.

The major factor influencing the approach for pericardial tap is the safety of the route. Trauma to surrounding structures (internal mammary artery, lung, stomach), or laceration of a coronary artery or the myocardium are the chief dangers. Infrequent complications noted are pneumothorax, ventricular tachycardia or fibrillation, and contamination of the pleural, mediastinal, or peritoneal space from purulent effusions as the needle is withdrawn from the pericardium. Each route has its own peculiar hazards. Punctures close to the sternum would appear especially dangerous because of contiguity to the internal mammary artery and greater likelihood of severance of a coronary vessel or laceration of the right auricle and ventricle. While the subxiphoid approach reaches the most dependent portion of the sac, the stomach, superior surface of the liver, superior epigastric artery, and the peritoneal cavity are within reach of the exploring needle. If the needle is directed behind the xiphoid and sternum, it would remain ventral to the peritoneum and thus avoid perforation of these structures. The apical route may traverse the pleural space and possibly the lingual tip of the left upper lobe of the lung and may approximate the anterior descending coronary artery in clockwise rotated hearts. The method which employs the left posterior thoracic approach will transfix the lung and probably its vasculature and may tear these structures during respiration.

All but three of the physicians answering the questionnaire have observed some ill effects from paracentesis. The majority have witnessed at least one death, generally attributed to laceration of coronary vessel or myocardium with fatal bleeding or to ventricular fibrillation. Mild shock-like symptoms, ventricular tachycardia, aspiration of blood from a heart chamber, and withdrawal of gastric juice from the stomach were also described in other, non-fatal cases. Suppurative pericarditis, constrictive pericarditis, and malignancy of the pericardium have increased the chances of hemorrhage from needling. Inasmuch as unfavorable effects were

widely observed, no one route appears free from danger.

There was unanimous agreement that internists as well as surgeons should perform pericardial aspiration after proper training and supervision. When cardiac wounds with recurrent tamponade following aspiration or purulent pericarditis are suspected, surgeons should be called upon for rib resection and exploration.

The amount of fluid removed varies with the case. Several of the replies favored removal of 200-500 cc. at the first tap; others inclined toward removal of as much as could be easily obtained, provided this was done slowly. Since tamponade is relieved by removal of small amounts (25-100 cc.), emptying the pericardial sac is probably unnecessary except in instances where rapid reaccumulation might be anticipated.

Air installation was recommended only for x-ray diagnostic purposes in order to delineate heart size, loculations of fluid, thickness of the sac, or possible neoplasm. Only three of the group suggested air installation in the treatment of tuberculosis pericardial effusion.

In addition to appropriate parenteral administration for bacterial infections of the pericardium, antibiotic solutions may be injected into the sac before the needle is withdrawn. However, the value of this procedure has not been clearly established. In tuberculous pericarditis treated at the Cincinnati General Hospital, in addition to parenteral streptomycin, 25 to 50 mgm. of streptomycin dissolved in 10 to 20 cc. of normal saline have been injected into the pericardial cavity without adverse effect. In purulent pericarditis caused by penicillin sensitive bacteria, 50,000 units of penicillin in 20 cc. of saline may be injected into the pericardium.

#### Summary

1. The techniques for pericardial paracentesis, the indications, the amount of fluid which should be removed, and treatment by parenteral and intrapericardial antibiotics of pericarditis with effusion are discussed.

2. The opinions of 17 of 21 leading cardiologists and cardiac surgeons indicate that either the antero-apical or subxiphoid routes are preferred to other approaches for pericardial paracentesis.

3. Eighteen of the 21 specialists consulted have witnessed at least one fatality due to, or following upon, pericardial paracentesis.

\* A questionnaire was circulated concerning the first and second choice of site for puncture, the dangers personally witnessed, including laceration of the myocardium and coronary vessels, qualifications of the operator, and amount of fluid usually removed. Answers were received from Drs. C. Beck, Cleveland; E. F. Bland, Boston; H. L. Blumgart, Boston; H. B. Burchell, Rochester, Minn.; C. S. Burwell, Boston; C. E. de La Chapelle, New York; D. C. Dilkin, Atlanta; R. E. Gross, Boston; A. Himelstein, New York; T. R. Harrison, Birmingham; F. D. Johnston, Ann Arbor; C. E. Kossman, New York; E. S. Orgain, Durham; I. H. Page, Cleveland; M. M. Ravitch, Baltimore; D. W. Richards, New York; M. C. Sosman, Boston; R. Wegria, New York; P. D. White, Boston; I. S. Wright, New York; C. Wolferth, Philadelphia.

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